PATENT ABSTRACTS OF JAPAN

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(71)Applicant : NIKON CORP
(72)Inventor : HAYASHI YUTAKA

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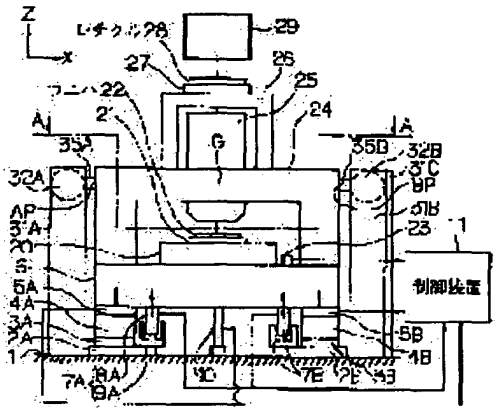
(54) VIBRATION CONTROL DEVICE

(57)Abstract:
PURPOSE: To maintain balance of reaction acting on a base member from respective plurality of vibration control pads arranged in a bottom of the base member such as a surface plate in desired state.
CONSTITUTION: A surface plate 6 is installed on a floor 1 through a set of up and down drive mechanism 3A, a vibration control pad 4A, a weighting sensor 5A, a second up and down drive mechanism 3B, a vibration control pad 4B, a weighting sensor 5B and the like and a wafer stage 20 and the like is mounted on the surface plate 6. Height of the vibration control pads 4A, 4B is adjusted through the up and down drive mechanisms based on height and inclination of the surface plate 6 detected by a displacement sensor 10 and a level sensor 23 and such that balance of reaction detected by the weighting sensors 5A, 5B are in desired state.



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CLAIMS

[Claim(s)]
[Claim 1] The vibration isolator characterized by providing the following. the base in which a processing object is laid -- a member Two or more three or more vibration absorbing pads arranged in a mutually different position between this base member and an installation side. Two or more load sensors which detect the load from the aforementioned base member to each of two or more of these vibration absorbing pads. Two or more height adjustment meanses to adjust each height of two or more aforementioned vibration absorbing pads according to the detection result of two or more of these load sensors.
[Claim 2] two or more aforementioned vibration absorbing pads -- respectively -- parallel -- between the aforementioned base member and installation sides -- the aforementioned base -- the vibration isolator according to claim 1 characterized by arranging two or more oscillating suppression meanses to suppress vibration of the height direction of a member
[Claim 3] the base member characterized by providing the following, and this base -- a member -- the vibration isolator for stage equipments which has the move stage which is fixed upwards and positions a processing object in the 1st direction which crosses mutually, and the direction of the 2nd Four vibration absorbing pads arranged in a mutually different position between the aforementioned base member and an installation side. this -- four load sensors which detect the load from the aforementioned base member which is alike, respectively and receives of four vibration absorbing pads Four height adjustment meanses to adjust each height of the four aforementioned vibration absorbing pads according to the detection result of the load sensor of these four individuals. this -- four height-adjustment meanses -- respectively -- ** -- it prepares in parallel -- having -- the aforementioned base -- the aforementioned base to the four 1st [which suppress the vibration to the height direction of a member] oscillating suppression means, and the 1st direction of the above -- 2nd two or more oscillating suppression means suppress vibration of a member, and the aforementioned base to the 2nd direction of the above -- 3rd one or more oscillating suppression means suppress vibration of a member
[Claim 4] the aforementioned base to the 1st direction of the above -- the aforementioned base to the point of application and the 2nd direction of the above of an oscillating suppression means of the above 2nd which suppresses vibration of a member -- the height of the point of application of the oscillating suppression means of the above 3rd which suppresses vibration of a member -- both -- the aforementioned base -- the height of the center of gravity of a system which consists of a member and the aforementioned move stage -- substantial -- etc. etc. -- the vibration isolator according to claim 3 characterized by the
[Claim 5] the aforementioned processing object -- a sensitization substrate -- it is -- the aforementioned base -- a member -- the vibration isolator according to claim 1, 2, 3, or 4 characterized by laying upwards the equipment which exposes a mask pattern to the aforementioned sensitization substrate

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention is applied to the vibrationproofing base of the aligner for exposing a mask pattern on a sensitization substrate, and relates to a suitable vibration isolator.
[0002]
[Description of the Prior Art] Conventionally, the aligners (stepper etc.) which carry out imprint exposure are used for each shot field of the wafers (or glass plate etc.) with which the pattern of the reticle as a mask was applied to the photoresist in the lithography process for manufacturing a semiconductor device or a liquid crystal display element. For example, in case the pattern of a reticle is exposed to each shot field of a wafer, it is necessary to make a reticle and a wafer stand it still nearly completely in the aligner of a package exposure method like a stepper. Then, the surface plate is installed above the floor level through the vibrationproofing base so that the vibration from a floor may not get across to the portion above the surface plate of an aligner (exposure book soma) as it is.
[0003] Moreover, in order to expose the pattern of a latus reticle on a wafer more, without enlarging a projection optical system recently, synchronizing with scanning a reticle in the direction perpendicular to the optical axis of a projection optical system, the scanning exposure type aligner of step - which exposes the pattern of a reticle serially on a wafer, - scanning method, etc. also attracts attention by scanning a wafer with the same velocity ratio as the scale factor of a projection optical system in the direction corresponding to it. In such a scanning exposure type aligner, since it is necessary to scan a reticle and a wafer stably at a respectively fixed speed during exposure, it is necessary to eliminate the vibration from a floor through a vibrationproofing base too.
[0004] The conventional vibrationproofing base currently used by the aligner arranges a vibration absorbing pad in the position of four vertices of a square above the floor level, respectively, and is constituted, and the surface plate of an aligner is installed on these four vibration absorbing pads. As the vibration absorbing pad, the air-operated damper or the mechanical damper which put in the helical compression spring into damping liquid was used, and it has the centering function in which the vibration absorbing pad itself is a certain grade. Moreover, in the aligner, since it is necessary to perform height adjustment and level level adjustment, these four vibration absorbing pads are equipped with the respectively mechanical vertical-movement mechanism. For example, since the flatness and the inclination state of a floor change and the inclination state of an exposure book soma also changes when the installation of an aligner is changed, in order to return it to the original state, height adjustment of a vibration absorbing pad is performed through a vertical-movement mechanism.
[0005]
[Problem(s) to be Solved by the Invention] In the conventional vibrationproofing base like the above, the height of an exposure book soma and level level adjustment can be performed by adjusting the vertical-movement mechanism prepared in each of four vibration absorbing pads. In this case, although a flat surface is determined by three points, since a vibration absorbing pad can be expanded and contracted in the vertical direction, the upper limit of four vibration absorbing pads touches the base of the surface plate, respectively. However, if these vertical-movement mechanism was adjusted, in order that the amount of expansion and contraction of each vibration absorbing pad might change and the balance of reaction force to the surface plate of an aligner might change from each vibration absorbing pad, the surface plate deformed, and there was un-arranging [that the positioning accuracy of the stage on the surface plate etc. got worse as a result].
[0006] Moreover, although most vibration which goes to an exposure book soma from a floor could be intercepted when a vibration absorbing pad was prepared, the latency time by the time vibration generated by stepping operation of for example, a wafer stage etc. within an exposure book soma declines, until the vibration will decline [comparatively long time] for this reason was needed, and there was un-arranging [that the throughput (productivity) of an exposure

process was not raised].

[0007] this invention -- this point -- taking an example -- the bases, such as a surface plate, -- two or more vibration absorbing pads arranged on the base of a member -- respectively -- since -- it aims at offering the vibration isolator which can maintain the balance of reaction force which acts on the base member in the desired state furthermore, the base where this invention is laid on these vibration absorbing pads -- a member -- it aims also at offering the vibration isolator which can attenuate quickly vibration produced in a top

[0008]

[Means for Solving the Problem] The 1st vibration isolator by this invention For example, the base member in which a processing object is laid as shown in drawing 1 - drawing 3 (6), Two or more three or more vibration absorbing pads arranged in a mutually different position between this base member and an installation side (4A-4D), Two or more load sensors which detect the load from the base member (6) to each of the vibration absorbing pad of these plurality (5A-5D), It has two or more height adjustment meanses (3A - 3D) to adjust each height of the vibration absorbing pad of these plurality according to the detection result of the load sensor of these plurality.

[0009] in this case, two or more vibration absorbing pads (4A-4D) -- respectively -- parallel -- between a base member (6) and installation sides -- the base -- it is desirable to arrange two or more oscillating suppression meanses (7A-7D) to suppress vibration of the height direction of a member Moreover, as the 2nd vibration isolator of this invention is shown in drawing 1 - drawing 3 </A> In the vibration isolator for stage equipments which has the move stage (20) which is fixed upwards and positions a processing object in the 1st direction which crosses mutually, and the direction of the 2nd a base member (6) and this base -- a member -- Four vibration absorbing pads arranged in a mutually different position between a base member (6) and an installation side (4A-4D), Four load sensors which detect the load from the base member (6) to each of these four vibration absorbing pads (5A-5D), Four height adjustment meanses to adjust each height of these four vibration absorbing pads (4A-4D) according to the detection result of these four load sensors (3A - 3D), these four height adjustment meanses -- respectively -- ** -- with 1st four oscillating suppression means (7A-7D) to be established in parallel and to suppress the vibration to the height direction of a base member (6) It has 2nd two or more oscillating suppression means (32A, 32B) to suppress vibration of the base member (6) to the 1st direction, and 3rd one or more oscillating suppression means (32C) to suppress vibration of the base member (6) to the 2nd direction.

[0010] In this case, the point of application of the 2nd oscillating suppression means (32A, 32B) which suppresses vibration of the base member (6) to the 1st direction (AP, BP), And it is desirable to make equal substantially both the height of the point of application (CP) of the 3rd oscillating suppression means (32C) which suppresses vibration of the base member (6) to the 2nd direction with the height of the center of gravity (G) of a system which consists of a base member (6) and a move stage (20).

[0011] Moreover, when the above-mentioned 1st and the 2nd vibration isolator are applied to an aligner, a processing object serves as a sensitization substrate and the exposure section which exposes a mask pattern to the sensitization substrate is laid on a base member (6).

[0012]

[Function] Since according to the 1st vibration isolator of this this invention the flatness and the inclination of installation sides (floor etc.) change in changing the installation of equipment, for example, the height of a base member (6) and tuning of level level are performed using the height adjustment means (3A - 3D) of a vibration absorbing pad (4A-4D). For example, depending on eye a possible hatchet and combination, the balance of reaction force whose base member (6) receives many kinds of combination of the amount of height adjustment by two or more height adjustment meanses (3A - 3D) for four or more vibration absorbing pads making a base member (6) predetermined height and predetermined level level in a certain case from a vibration absorbing pad will change.

[0013] Then, in this invention, the reaction force received from a vibration absorbing pad is measured by the direct load sensor (5A-5D), and the amount of adjustments in each height adjustment means (3A - 3D) is controlled so that the balance of the reaction force received from each vibration absorbing pad does not change. Thereby, deformation of a base member (6) is prevented. furthermore, two or more vibration absorbing pads (4A-4D) -- respectively -- parallel -- between a base member (6) and installation sides -- the base -- when two or more oscillating suppression meanses (7A-7D) to suppress vibration of the height direction of a member have been arranged, vibration generated in the upper part of a base member (6) is attenuated with the oscillating suppression means

[0014] Moreover, according to the 2nd vibration isolator of this invention, the height of four vibration absorbing pads (4A-4D) is adjusted through four height adjustment meanses (3A - 3D) so that the balance of the reaction force measured by four load sensors (5A-5D) may be set as a predetermined state. Furthermore, 1st four oscillating suppression means to suppress vibration of the height direction (7A-7D), Vibration which has the flexibility of six or more pieces generated on a base member (6) by two or more 2nd oscillating suppression means (32A, 32B) to suppress

the vibration to the 1st direction, and 3rd one or more oscillating suppression means (32C) to suppress the vibration to the 2nd direction is suppressed.

[0015] In this case, the point of application of the 2nd oscillating suppression means (32A, 32B) which suppresses vibration of the base member (6) to the 1st direction (AP, BP), The height of the point of application (CP) of the 3rd oscillating suppression means (32C) which suppresses vibration of the base member (6) to the 2nd direction and both When it is substantially made equal with the height of the center of gravity (G) of a system which consists of a base member (6) and a move stage (20), rotation generating the surroundings of the 1st direction and around the direction of the 2nd is suppressed. Moreover, since advancing-side-by-side movement in surrounding rotation of a direction (Z direction) perpendicular to the 1st direction and the direction of the 2nd, its 1st direction, and the direction of the 2nd is controllable by the 2nd oscillating suppression means (32A, 32B) and the 3rd oscillating suppression means (32C), interference between shafts is suppressed to the minimum.

[0016]

[Example] Hereafter, with reference to a drawing, it explains per example of the vibration isolator by this invention. this example applies this invention to the vibrationproofing base of a stepper type projection aligner. drawing 1 -- the front view of the projection aligner of this example -- being shown -- this drawing 1 -- setting -- the floor 1 top as an installation side -- four plinth 2A and 2Bs, and -- (only 2A and 2B have appeared in drawing 1 --) the following -- being the same -- it is installed, vibration absorbing pads 4A-4D are installed through the vertical-movement mechanisms 3A-3C, respectively on these four plinth 2A and 2Bs, and --, and the surface plate 6 of a projection aligner is installed through the load sensors 5A-5D on these vibration-absorbing-pad 4A - 4D Here, like the after-mentioned, by this example, since the projection optical system 25 is used, the Z-axis is taken in parallel with the optical axis of a projection optical system 25, and a Y-axis is taken for the X-axis at right angles to the space of drawing 1 in parallel with the space of drawing 1 within a flat surface perpendicular to the Z-axis.

[0017] As drawing 3 shows the cross section which meets AA line of drawing 1 and shows it to this drawing 3 , vertical-movement mechanism 3A - 3D, vibration absorbing pads 4A-4D, and the load sensors 5A-5D are arranged near [four vertices] the base of the square of a surface plate 6, respectively. The height adjustment mechanism of the electric formula which is made to rotate a screw thread with a drive motor for example, and adjusts height as vertical-movement mechanism 3A - 3D is used, and the amount of height adjustment to the Z direction of vertical-movement mechanism 3A - 3D is controlled by the control unit 11 which carries out control control of the operation of the whole equipment. Moreover, as vibration absorbing pads 4A-4D, an air-operated damper or the mechanical damper which put in the helical compression spring into damping liquid is used. Since the pressure of air can adjust the height of vibration absorbing pads 4A-4D when using an air-operated damper as vibration absorbing pads 4A-4D, the air-operated damper can make vertical-movement mechanism 3A - 3D, and vibration absorbing pads 4A-4D serve a double purpose, respectively. Moreover, as load sensors 5A-5D, the load cell which consists of a strain gage etc. can be used, and the reaction force of the load from the surface plate 6 measured by the load sensors 5A-5D, i.e., the Z direction to a surface plate 6 from vibration absorbing pads 4A-4D, is supplied to the control unit 11.

[0018] It returns to drawing 1 and actuator 7A is installed in parallel with vibration-absorbing-pad 4A between plinth 2A and the surface plate 6. Actuator 7A consists of stator 9A fixed on plinth 2A, and needle 8A fixed to the base of a surface plate 6, and actuator 7A generates the energization force from plinth 2A to the Z direction to the base of a surface plate 6, or the suction force which goes to plinth 2A from the base of a surface plate 6 according to the directions from a control unit 11. Also in other vibration absorbing pads 4B-4D, Actuators 7B-7D are installed in parallel like vibration-absorbing-pad 4A, respectively, and the energization force or suction force of these actuators 7B-7D is also set up by the control unit 11, respectively. Since Actuators 7A-7D are the same composition, they are explained per composition of actuator 7A.

[0019] Drawing 2 (a) shows actuator 7A of this example, and stator 9A consists of ****** by which shaft 9Ab of the south pole and 9Ac were formed in the both sides of shaft 9Aa of N pole in this drawing 2 (a). Moreover, needle 8A consists of wrap outer cases 14 in the container liner 12 which fits loosely into shaft 9Aa, the coil 13 wound around the outside of this container liner 12, and this coil 13, and the force to a direction (**Z direction) parallel to shaft 9Aa generates it between stator 9A and needle 8A by adjusting the current which flows in a coil 13.

[0020] Drawing 2 (b) shows another example of the actuator 7A, in this drawing 2 (b), the stator 16 of the magnetic substance is fixed to the part I material 15, container liners 18A and 18B are fixed so that a stator 16 may be inserted into the part II material 17, and Coils 19A and 19B are wound around the outside of container liners 18A and 18B, respectively. By adjusting the current passed in Coils 19A and 19B also in this case, the balance of the suction force between the part I material 15 and the part II material 17 is changed, and the force is generated.

[0021] It returns to drawing 1 , and the displacement sensor 10 for detecting the variation rate to the Z direction of a surface plate 6 to a floor 1 is installed between a floor 1 and the center section of the base of a surface plate 6, and the

detection result of a displacement sensor 10 is also supplied to the control unit 11. As a displacement sensor 10, the linear encoder of a potentiometer with a resolution of about 0.1mm or a photoelectrical formula etc. can be used, for example.

[0022] Moreover, the wafer stage 20 is fixed on a surface plate 6, and adsorption maintenance of the wafer 22 is carried out through the wafer electrode holder 21 on the wafer stage 20. The 1st column 24 is implanted so that the wafer stage 20 may be surrounded on a surface plate 6, a projection optical system 25 is fixed to the center section of the finish plate of the 1st column 24, the 2nd column 26 is implanted so that a projection optical system 25 may be surrounded to the finish plate of the 1st column 24, and the reticle 28 is laid in the center section of the finish plate of the 2nd column 26 through the reticle stage 27. The wafer stage 20 has the function to perform rotation of a wafer 22 and leveling while positioning a wafer 22 in three dimensions, and a reticle stage 27 has the function to perform fine tuning of the two-dimensional position of a reticle 28, and adjustment of an angle of rotation. The lighting optical system 29 is arranged above a reticle 28, and the image which minded the projection optical system 25 of the pattern of a reticle 28 under the lighting light for the exposure from the lighting optical system 29 is exposed one by one by each shot field of a wafer 22.

[0023] As shown in drawing 3 , the 1st column 24 touches on a surface plate 6 by the four legs 24a-24d. Moreover, the acceleration sensor 30 for detecting the level sensor 23 for detecting the amount of gaps of the tilt angle from the level surface near the wafer stage 20 on a surface plate 6 and the acceleration of a surface plate 6 is installed, and the detection result by the level sensor 23 and the acceleration sensor 30 is supplied to the control unit 11. An acceleration sensor 30 has the function to detect the acceleration (angular acceleration) of the hand of cut within pitching (rotation in XZ flat surface), yawing (rotation in YZ flat surface), and XY flat surface other than the acceleration to the direction of X, the direction of Y, and a Z direction. That is, an acceleration sensor 30 has the function to detect the acceleration which has the flexibility of six pieces.

[0024] Furthermore, movable shaft 35A is embedded on the side of the direction of -X of a surface plate 6, and actuator 32A is attached between movable shaft 35A and support 31A fixed above the floor level. Actuator 32A consists of stator 34A which consists of ****** fixed to support 31A like actuator 7A, and needle 33A containing the coil attached in movable shaft 35A, and can give the force in the direction of +Y, or the direction of -Y to movable shaft 35A by adjusting the current which flows in the coil in needle 33A from a control unit 11.

[0025] Similarly, movable shaft 35B can be embedded on the side of the direction of +X of a surface plate 6, actuator 32B of the same composition as actuator 32A can be attached between movable shaft 35B and support 31B fixed above the floor level, and the force can be given now in the direction of +Y, or the direction of -Y to movable shaft 35B with the directions from a control unit 11. Moreover, actuator 32C which consists of stator 34C and needle 33C is installed between the center section of the side of the direction of +X of a surface plate 6, and support 31C above the floor level, and the force can be given in the direction of +X, or the direction of -X to a surface plate 6 through actuator 32C with the directions from a control unit 11.

[0026] Moreover, it returns to drawing 1 and Supports 31A, 31B, and 31C are implanted above the floor level along with the 1st column 24, respectively. And suppose that the center of gravity of a system which consists of a surface plate 6, the wafer stage 20, the wafer electrode holder 21, one column 24, a projection optical system 25, the 2nd column 26, and a reticle stage 27 is in a position G. Furthermore, as it is shown in drawing 3 , using the center of a connection with the 1st column 24 of the movable shafts 35A and 35B by Actuators 32A and 32B as point of application AP and BP, respectively, let the center of a connection with the 1st column 24 of needle 34C of actuator 32C be point of application CP. At this time, the position of the Z direction of three point of application AP, BP, and CP is set as the same position (height) by the Z direction to the center-of-gravity position G by this example, respectively.

[0027] Next, it explains per operation of this example. First, in this example, as shown in drawing 1 and drawing 3 , the reaction force to the surface plate 6 of each vibration-absorbing-pad 4A-4D of every [which was measured by the load sensors 5A-5D] is told to the control unit 11. Moreover, the level level of the surface plate 9 measured by the level sensor 23 on a surface plate 6 and the height of the surface plate 6 measured by the displacement sensor 10 are also told to the control unit 11. A control unit 11 computes the height of each vibration absorbing pads 4A-4D for making the height and level level (tilt angle) of a surface plate 6 into the value set up beforehand, respectively based on these data. The height of each vibration absorbing pads 4A-4D is decided that the balance of the reaction force told to a surface plate 6 will be in the state where it is set up beforehand from each vibration absorbing pads 4A-4D in that case. Then, a control unit 11 sets the height of vibration absorbing pads 4A-4D as the computed height through vertical-movement mechanism 3A - 3D, respectively. Then, the height of vibration absorbing pads 4A-4D is maintained by the set point, respectively. Thereby, distortion does not arise in a surface plate 6 and the positioning accuracy of the wafer stage 20 on a surface plate 6 etc. is maintained with high precision.

[0028] Next, as shown in drawing 3 , the information on the acceleration of 6 flexibility detected by the acceleration sensor 30 on a surface plate 6 is supplied to the control unit 11. Then, a control unit 11 drives four actuators 7A-7D for Z directions, two actuators 32A and 32B for the directions of Y, and one actuator 32for the X-axes C so that acceleration of the 6 flexibility may be set to 0, respectively. By this, **** of 6 flexibility of the exposure book soma on a surface plate 6 can be stopped.
[0029] At this time, the point of application CP of actuator 32C for the X-axes and the point of application AP and BP of two actuators 32A and 32B for Y-axes are installed in the almost equal position (height) by the Z direction to the center-of-gravity position G of the vibration system on the surface plate 6 of this example (oscillating suppression object). Therefore, since advancing-side-by-side vibration of rotation of the circumference of the Z-axis, the X-axis, and Y shaft orientations can be controlled by the actuators 32A and 32B actuator 32C for the X-axes, and for Y-axes, without generating rotation of the circumference of the X-axis and a Y-axis, interference between shafts is suppressed to the minimum.
[0030] In addition, in the above-mentioned example, although set as the almost same height to the center-of-gravity position G, the point of application CP of actuator 32C for the X-axes and the point of application AP and BP of the actuators 32A and 32B for Y-axes do not necessarily need to double the height of those point-of-application AP-CP with the center-of-gravity position G, when the interference between shafts of a certain grade can be permitted. Moreover, you may make it set the point of application CP of actuator 32C for the X-axes as the almost same height to the center-of-gravity position G, for example.
[0031] In addition, although the above-mentioned example applies this invention to the projection aligner of a stepper method, this invention is applicable also to the scanning exposure type projection aligner of step -, - scanning method, etc. Especially the vibrationproofing base where it has the actuator which stops **** of a surface plate 6 like this example since big acceleration occurs in a scanning exposure type at the time of the start of scanning exposure is effective.
[0032] Moreover, although the actuators 7A-7D for Z directions are formed apart from vertical-movement mechanism 3A - 3D in drawing 1 , you may make the actuator serve a double purpose by vertical-movement mechanism 3A - 3D. However, there is an advantage which is the few force and can suppress **** of a surface plate 6 by the high speed of response by using the actuators 7A-7D arranged at vibration absorbing pads 4A-4D and parallel. Furthermore, in the base of a surface plate 6, four or more vibration absorbing pads may be arranged, and the actuator of 6 or more flexibility may be arranged.
[0033] Thus, this invention is not limited to the above-mentioned example, but can take composition various in the range which does not deviate from the summary of this invention.
[0034]
[Effect of the Invention] According to the 1st vibration isolator of this invention, since it is made to control the amount of adjustments of a height adjustment means according to the detection result of a load sensor, it can maintain from two or more vibration absorbing pads in the state of a request of the balance of reaction force to a base member (surface plate), and there is an advantage which can lessen distortion generated in a base member.
[0035] moreover, the thing for which an oscillating suppression means is established -- the base -- a member -- there is an advantage which can suppress vibration generated in a top the force in which it is few when arranging the oscillating suppression means to a vibration absorbing pad and parallel especially -- and a high speed of response -- the base -- a member -- vibration generated in a top can be suppressed next -- while being able to set the balance of reaction force to a base member as a desired state from a vibration absorbing pad according to the 2nd vibration isolator of this invention -- the sum total -- seven or more oscillating suppression meanses -- minding -- the base -- a member -- there is an advantage which can suppress quickly vibration of 6 flexibility generated in a top therefore, the base -- a member -- the positioning accuracy of the upper move stage is maintained with high precision
[0036] moreover, the base to the 1st direction -- the base to the point of application of the 2nd oscillating suppression means which suppresses vibration of a member, and the direction of the 2nd -- the height of the point of application of the 3rd oscillating suppression means which suppresses vibration of a member -- both -- the base -- the height of the center of gravity of a system which consists of a member and a move stage -- substantial -- etc. -- when [at which it spreads] it carries out, an axial interference can be suppressed to the minimum Level level adjustment can be performed without deformation producing exposure book somata (a surface plate, wafer stage, etc.), even when an installation is changed, if especially this invention is applied to an aligner. Furthermore, in order to add a new function to an exposure book soma, in case a new mechanism is added and the center of gravity of an exposure book soma changes, a height adjustment means can be controlled so that change of the reaction force balance from a vibration absorbing pad becomes the minimum.

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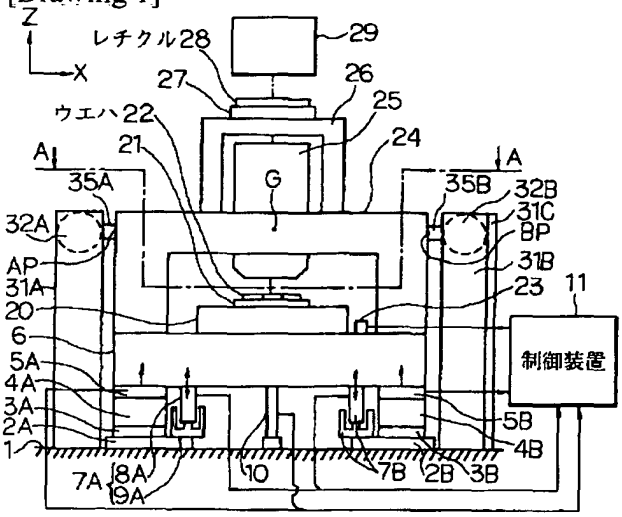
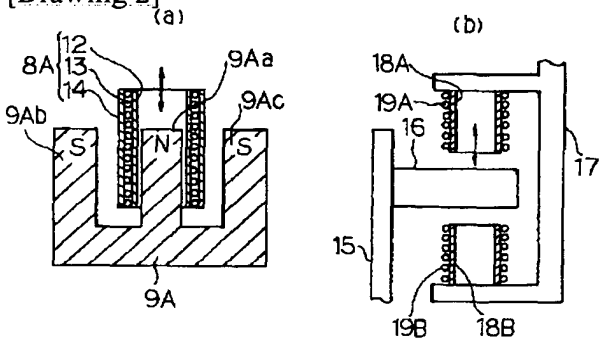
DRAWINGS

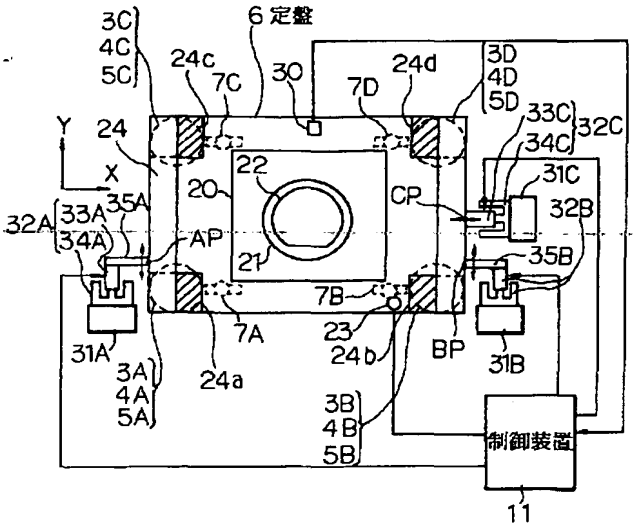
[Drawing 1]



[Drawing 2]



[Drawing 3]



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G05D 19/02 .
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F16F 15/04 A .
15/02 A .
G05D 19/02 D .
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[Procedure amendment 1]
[Document to be Amended] Specification.
[Item(s) to be Amended] The name of invention.
[Method of Amendment] Change.
[Proposed Amendment]
[Title of the Invention] A vibration isolator and a scanned type aligner.
[Procedure amendment 2]
[Document to be Amended] Specification.
[Item(s) to be Amended] Claim.
[Method of Amendment] Change.
[Proposed Amendment]
[Claim(s)]
[Claim 1] The base member in which a processing object is laid,
Two or more three or more vibration absorbing pads arranged in a mutually different position between this base member and an installation side,
Two or more load sensors which detect the load from the aforementioned base member to each of two or more of these vibration absorbing pads,
The vibration isolator characterized by having two or more height adjustment meanses to adjust each height of two or more aforementioned vibration absorbing pads according to the detection result of two or more of these load sensors.
[Claim 2] two or more aforementioned vibration absorbing pads -- respectively -- parallel -- between the

aforementioned base member and installation sides -- the aforementioned base -- the vibration isolator according to claim 1 characterized by arranging two or more oscillating suppression meanses to suppress vibration of the height direction of a member
[Claim 3] a base member and this base -- a member -- the vibration isolator for stage equipments which has the move stage which is fixed upwards and positions a processing object in the 1st direction which crosses mutually, and the direction of the 2nd -- setting
Four vibration absorbing pads arranged in a mutually different position between the aforementioned base member and an installation side,
this -- four load sensors which detect the load from the aforementioned base member which is alike, respectively and receives of four vibration absorbing pads
Four height adjustment meanses to adjust each height of the four aforementioned vibration absorbing pads according to the detection result of the load sensor of these four individuals,
this -- four height adjustment meanses -- respectively -- ** -- it prepares in parallel -- having -- the aforementioned base -- 1st four oscillating suppression means to suppress the vibration to the height direction of a member
the aforementioned base to the 1st direction of the above -- 2nd two or more oscillating suppression means to suppress vibration of a member
the aforementioned base to the 2nd direction of the above -- the vibration isolator characterized by having 3rd one or more oscillating suppression means to suppress vibration of a member
[Claim 4] the aforementioned base to the 1st direction of the above -- the aforementioned base to the point of application and the 2nd direction of the above of an oscillating suppression means of the above 2nd which suppresses vibration of a member -- the height of the point of application of the oscillating suppression means of the above 3rd which suppresses vibration of a member -- both -- the aforementioned base -- the height of the center of gravity of a system which consists of a member and the aforementioned move stage -- substantial -- etc. etc. -- the vibration isolator according to claim 3 characterized by the
[Claim 5] the aforementioned processing object -- a sensitization substrate -- it is -- the aforementioned base -- a member -- the vibration isolator according to claim 1, 2, 3, or 4 characterized by laying upwards the equipment which exposes the pattern of a mask to the aforementioned sensitization substrate
[Claim 6] In the scanned type aligner which carries out the synchronized drive of a mask and the sensitization substrate, and exposes the pattern of the aforementioned mask to the aforementioned sensitization substrate
The projection optical system which is prepared between the aforementioned mask and the aforementioned sensitization substrate, and projects the aforementioned pattern on the aforementioned sensitization substrate,
The mask stage which holds the aforementioned mask and moves,
The substrate stage where holds the aforementioned sensitization substrate and it moves,
The scanned type aligner characterized by having the actuator which is formed between the base member which holds the aforementioned mask stage and the aforementioned projection optical system at least, and the aforementioned base member and an installation side, and gives the force along the direction of the optical axis of the aforementioned projection optical system to the aforementioned base member.
[Claim 7] The aforementioned base member is a scanned type aligner according to claim 6 characterized by holding the aforementioned substrate stage.
[Claim 8] The scanned type aligner according to claim 6 or 7 characterized by having the control unit which controls the aforementioned actuator and gives the aforementioned force into the aforementioned synchronized drive of the aforementioned mask and the aforementioned sensitization substrate at the aforementioned base member.
[Claim 9] the aforementioned base -- the scanned type aligner according to claim 8 characterized by having detected the acceleration of a member and having the acceleration sensor which outputs this detection result to the aforementioned control unit
[Procedure amendment 3]
[Document to be Amended] Specification.
[Item(s) to be Amended] 0011.
[Method of Amendment] Change.
[Proposed Amendment]
[0011] Moreover, when the above-mentioned 1st and the 2nd vibration isolator are applied to an aligner, a processing object serves as a sensitization substrate and the exposure section which exposes a mask pattern to the sensitization substrate is laid on a base member (6). Next, the scanned type aligner of this invention carries out the synchronized drive of the sensitization substrate (22) to a mask (28). The projection optical system which is the scanned type aligner which exposes the pattern of a mask (28) to a sensitization substrate (22), is prepared between a mask (28) and a

sensitization substrate (22), and projects a pattern on a sensitization substrate (22) (25), The mask stage (27) which holds a mask (28) and moves, and the substrate stage where hold a sensitization substrate (22) and it moves (20), The base member which holds a mask stage (27) and a projection optical system (25) at least (6), It is prepared between a base member (6) and an installation side, and has the actuator (7) which gives the force along the direction of the optical axis of a projection optical system (25) to a base member (6). In this case, a base member (6) may hold a substrate stage (20). Moreover, it is desirable to have the control unit which controls an actuator (7) and gives the force into the synchronized drive of a mask (28) and a sensitization substrate (22) at a base member (6). Furthermore, the acceleration of a base member (6) may be detected and you may have the acceleration sensor (30) which outputs this detection result to the control unit.

[Procedure amendment 4]
[Document to be Amended] Specification.
[Item(s) to be Amended] 0015.
[Method of Amendment] Change.
[Proposed Amendment]
[0015] In this case, the point of application of the 2nd oscillating suppression means (32A, 32B) which suppresses vibration of the base member (6) to the 1st direction (AP, BP), The height of the point of application (CP) of the 3rd oscillating suppression means (32C) which suppresses vibration of the base member (6) to the 2nd direction and both When it is substantially made equal with the height of the center of gravity (G) of a system which consists of a base member (6) and a move stage (20), rotation generating the surroundings of the 1st direction and around the direction of the 2nd is suppressed. Moreover, since advancing-side-by-side movement in surrounding rotation of a direction (Z direction) perpendicular to the 1st direction and the direction of the 2nd, its 1st direction, and the direction of the 2nd is controllable by the 2nd oscillating suppression means (32A, 32B) and the 3rd oscillating suppression means (32C), interference between shafts is suppressed to the minimum. Moreover, the actuator (7) has given the force along the direction of the optical axis of a projection optical system (25) to the base member (6) to which the scanned type aligner of this invention holds a mask stage (27) and a projection optical system (25) at least.
[Procedure amendment 5]
[Document to be Amended] Specification.
[Item(s) to be Amended] 0036.
[Method of Amendment] Change.
[Proposed Amendment]
[0036] moreover, the base to the 1st direction -- the base to the point of application of the 2nd oscillating suppression means which suppresses vibration of a member, and the direction of the 2nd -- the height of the point of application of the 3rd oscillating suppression means which suppresses vibration of a member -- both -- the base -- the height of the center of gravity of a system which consists of a member and a move stage -- substantial -- etc. -- when [at which it spreads] it carries out, interference between shafts can be suppressed to the minimum Level level adjustment can be performed without making exposure book somata (a surface plate, wafer stage, etc.) produce deformation, if especially this invention is applied to an aligner, even when an installation is changed. Furthermore, in order to add a new function to an exposure book soma, in case a new mechanism is added and the center of gravity of an exposure book soma changes, a height adjustment means can be controlled so that change of the reaction force balance from a vibration absorbing pad becomes the minimum. Moreover, since the actuator has given the force along the direction of the optical axis of a projection optical system to the base member which holds a mask stage and a projection optical system at least according to the scanned type aligner of this invention, the influence by movement of a mask stage can be suppressed.

[Translation done.]

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(71)出願人　000004112
株式会社ニコン
東京都千代田区丸の内3丁目2番3号

(72)発明者　林　豊
東京都千代田区丸の内3丁目2番3号　株式会社ニコン内

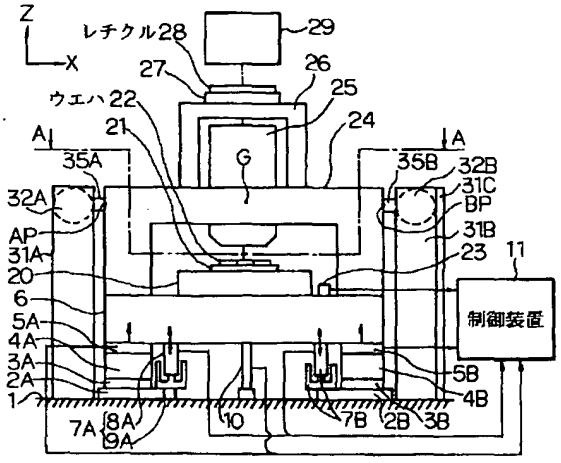
(74)代理人　弁理士　大森　聡

(54)【発明の名称】防振装置

(57)【要約】

【目的】　定盤等のベース部材の底面に配置された複数個の防振パッドのそれぞれからそのベース部材に作用する反力のバランスを所望の状態に維持する。

【構成】　床1上に第1組の上下動機構3A、防振パッド4A、加重センサ5A、第2組の上下動機構3B、防振パッド4B、加重センサ5B等を介して定盤6を設置し、定盤6上にウエハステージ20等を載置する。変位センサ10、及びレベルセンサ23で検出される定盤6の高さ、及び傾斜角に基づいて、且つ加重センサ5A，5Bにより検出される反力のバランスが所望の状態となるように上下動機構3A，3Bを介して防振パッド4A，4Bの高さを調整する。



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【特許請求の範囲】

【請求項1】　処理対象物が載置されるベース部材と、該ベース部材と設置面との間の互いに異なる位置に配置される3個以上の複数の防振パッドと、該複数の防振パッドのそれぞれに対する前記ベース部材からの荷重を検出する複数の荷重センサと、該複数の荷重センサの検出結果に応じて前記複数の防振パッドのそれぞれの高さを調整する複数の高さ調整手段と、を有することを特徴とする防振装置。

【請求項2】　前記複数の防振パッドとそれぞれ並列に、前記ベース部材と設置面との間に前記ベース部材の高さ方向の振動を抑制する複数の振動抑制手段を配置することを特徴とする請求項1記載の防振装置。

【請求項3】　ベース部材と、該ベース部材上に固定されて処理対象物を互いに交差する第1の方向及び第2の方向に位置決めする移動ステージとを有するステージ装置用の防振装置において、前記ベース部材と設置面との間で互いに異なる位置に配置される4個の防振パッドと、該4個の防振パッドのそれぞれに対する前記ベース部材からの荷重を検出する4個の荷重センサと、該4個の荷重センサの検出結果に応じて前記4個の防振パッドのそれぞれの高さを調整する4個の高さ調整手段と、該4個の高さ調整手段のそれぞれと並列に設けられ前記ベース部材の高さ方向への振動を抑制する4個の第1の振動抑制手段と、前記第1の方向に対する前記ベース部材の振動を抑制する2個以上の第2の振動抑制手段と、前記第2の方向に対する前記ベース部材の振動を抑制する1個以上の第3の振動抑制手段と、を有することを特徴とする防振装置。

【請求項4】　前記第1の方向に対する前記ベース部材の振動を抑制する前記第2の振動抑制手段の作用点、及び前記第2の方向に対する前記ベース部材の振動を抑制する前記第3の振動抑制手段の作用点の高さを共に、前記ベース部材及び前記移動ステージよりなる系の重心の高さと実質的に等しくしたことを特徴とする請求項3記載の防振装置。

【請求項5】　前記処理対象物が感光基板であり、前記ベース部材上に前記感光基板にマスクパターンを露光する装置が載置されることを特徴とする請求項1、2、3又は4記載の防振装置。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、例えばマスクパターンを感光基板上に露光するための露光装置の防振台に適用して好適な防振装置に関する。

【0002】

【従来の技術】従来より、半導体素子、又は液晶表示素子等を製造するためのリソグラフィ工程において、マスクとしてのレチクルのパターンをフォトレジストが塗布されたウエハ（又はガラスプレート等）の各ショット領域に転写露光する露光装置（ステッパ等）が使用されている。例えばステッパのような一括露光方式の露光装置において、レチクルのパターンをウエハの各ショット領域に露光する際には、レチクルとウエハとをほぼ完全に静止させておく必要がある。そこで、床からの振動が露光装置の定盤より上の部分（露光本体部）にそのまま伝わらないように、その定盤は床上に防振台を介して設置されている。

【0003】また、最近は、投影光学系を大型化することなく、より広いレチクルのパターンをウエハ上に露光するために、レチクルを投影光学系の光軸に垂直な方向に走査するのと同期して、それに対応する方向にウエハを投影光学系の倍率と同じ速度比で走査することにより、レチクルのパターンをウエハ上に逐次露光するステップ・アンド・スキャン方式等の走査露光型の露光装置も注目されている。このような走査露光型の露光装置では、露光中にレチクルとウエハとをそれぞれ一定の速度で安定に走査する必要があるため、やはり防振台を介して床からの振動を排除する必要がある。

【0004】露光装置で使用されている従来の防振台は、床上の四角形の4個の頂点の位置にそれぞれ防振パッドを配置して構成され、それら4個の防振パッド上に露光装置の定盤が設置されている。その防振パッドとしては、空気式ダンパ、又はダンピング液中に圧縮コイルばねを入れた機械式ダンパ等が使用され、防振パッド自体が或る程度のセンタリング機能を備えている。また、露光装置では高さ調整、及び水平レベル調整を行う必要があるため、それら4個の防振パッドにはそれぞれ機械式の上下動機構が備えられている。例えば露光装置の設置場所を変更したような場合には、床の平面度及び傾斜状態が変化して露光本体部の傾斜状態も変化するため、それを元の状態に戻すために上下動機構を介して防振パッドの高さ調整が行われる。

【0005】

【発明が解決しようとする課題】上記の如き従来の防振台においては、4個の防振パッドのそれぞれに設けられた上下動機構を調整することにより、露光本体部の高さ及び水平レベル調整を行うことができる。この場合、平面は3点で決定されるが、防振パッドは上下方向に伸縮できるため、4個の防振パッドの上端がそれぞれその定盤の底面に接触している。しかしながら、それら上下動機構を調整すると、各防振パッドの伸縮量が変化して、各防振パッドから露光装置の定盤に対する反力のバランスが変化するために定盤が変形し、結果としてその定盤上のステージの位置決め精度等が悪化するという不都合があった。

【0006】また、防振パッドを設けた場合には床から

露光本体部に向かう振動はほとんど遮断できるが、露光本体部内で例えばウエハステージのステッピング動作等によって発生する振動が減衰するまでに比較的長い時間がかかるため、その振動が減衰するまでの待ち時間が必要となり、露光工程のスループット（生産性）が高められないという不都合があった。

【０００７】本発明は斯かる点に鑑み、定盤等のベース部材の底面に配置された複数個の防振パッドのそれぞれからそのベース部材に作用する反力のバランスを所望の状態に維持できる防振装置を提供することを目的とする。更に本発明は、それら防振パッドの上に載置されるベース部材上で生ずる振動を迅速に減衰させることができる防振装置を提供することをも目的とする。

【０００８】

【課題を解決するための手段】本発明による第１の防振装置は、例えば図１～図３に示すように、処理対象物が載置されるベース部材（６）と、このベース部材と設置面との間の互いに異なる位置に配置される３個以上の複数の防振パッド（４Ａ～４Ｄ）と、これら複数の防振パッドのそれぞれに対するベース部材（６）からの荷重を検出する複数の荷重センサ（５Ａ～５Ｄ）と、これら複数の荷重センサの検出結果に応じてそれら複数の防振パッドのそれぞれの高さを調整する複数の高さ調整手段（３Ａ～３Ｄ）と、を有するものである。

【０００９】この場合、複数の防振パッド（４Ａ～４Ｄ）とそれぞれ並列に、ベース部材（６）と設置面との間にそのベース部材の高さ方向の振動を抑制する複数の振動抑制手段（７Ａ～７Ｄ）を配置することが望ましい。また、本発明の第２の防振装置は、例えば図１～図３に示すように、ベース部材（６）と、このベース部材上に固定されて処理対象物を互いに交差する第１の方向及び第２の方向に位置決めする移動ステージ（２０）とを有するステージ装置用の防振装置において、ベース部材（６）と設置面との間で互いに異なる位置に配置される４個の防振パッド（４Ａ～４Ｄ）と、これら４個の防振パッドのそれぞれに対するベース部材（６）からの荷重を検出する４個の荷重センサ（５Ａ～５Ｄ）と、これら４個の荷重センサの検出結果に応じてそれら４個の防振パッド（４Ａ～４Ｄ）のそれぞれの高さを調整する４個の高さ調整手段（３Ａ～３Ｄ）と、これら４個の高さ調整手段のそれぞれと並列に設けられベース部材（６）の高さ方向への振動を抑制する４個の第１の振動抑制手段（７Ａ～７Ｄ）と、その第１の方向に対するベース部材（６）の振動を抑制する２個以上の第２の振動抑制手段（３２Ａ，３２Ｂ）と、その第２の方向に対するベース部材（６）の振動を抑制する１個以上の第３の振動抑制手段（３２Ｃ）と、を有するものである。

【００１０】この場合、その第１の方向に対するベース部材（６）の振動を抑制する第２の振動抑制手段（３２Ａ，３２Ｂ）の作用点（ＡＰ，ＢＰ）、及びその第２の方向に対するベース部材（６）の振動を抑制する第３の振動抑制手段（３２Ｃ）の作用点（ＣＰ）の高さを共に、ベース部材（６）及び移動ステージ（２０）よりなる系の重心（Ｇ）の高さと実質的に等しくすることが望ましい。

【００１１】また、上述の第１及び第２の防振装置を露光装置に適用した場合、処理対象物が感光基板となり、ベース部材（６）上にその感光基板にマスクパターンを露光する露光部が載置される。

【００１２】

【作用】斯かる本発明の第１の防振装置によれば、例えば装置の設置場所を変更する場合には、設置面（床等）の平面度及び傾斜が変わるため、防振パッド（４Ａ～４Ｄ）の高さ調整手段（３Ａ～３Ｄ）を用いてベース部材（６）の高さ及び水平レベルの調整作業を行う。例えば防振パッドが４個以上ある場合、ベース部材（６）を所定の高さ及び水平レベルにするための複数の高さ調整手段（３Ａ～３Ｄ）による高さ調整量の組合せは何通りも可能なため、組合せによってはベース部材（６）が防振パッドより受ける反力のバランスが変化してしまう。

【００１３】そこで本発明においては、防振パッドより受ける反力を直接加重センサ（５Ａ～５Ｄ）で測定し、各防振パッドから受ける反力のバランスが変化しないように各高さ調整手段（３Ａ～３Ｄ）での調整量を制御する。これによりベース部材（６）の変形が防止される。更に、複数の防振パッド（４Ａ～４Ｄ）とそれぞれ並列に、ベース部材（６）と設置面との間にそのベース部材の高さ方向の振動を抑制する複数の振動抑制手段（７Ａ～７Ｄ）を配置した場合、ベース部材（６）の上部で発生した振動をその振動抑制手段で減衰させる。

【００１４】また、本発明の第２の防振装置によれば、４個の加重センサ（５Ａ～５Ｄ）で計測される反力のバランスを所定の状態に設定するように、４個の高さ調整手段（３Ａ～３Ｄ）を介して４個の防振パッド（４Ａ～４Ｄ）の高さを調整する。更に、高さ方向の振動を抑制する４個の第１の振動抑制手段（７Ａ～７Ｄ）と、第１の方向に対する振動を抑制する２個以上の第２の振動抑制手段（３２Ａ，３２Ｂ）と、第２の方向に対する振動を抑制する１個以上の第３の振動抑制手段（３２Ｃ）とにより、ベース部材（６）上で発生する６個以上の自由度を有する振動が抑制される。

【００１５】この場合、その第１の方向に対するベース部材（６）の振動を抑制する第２の振動抑制手段（３２Ａ，３２Ｂ）の作用点（ＡＰ，ＢＰ）、及びその第２の方向に対するベース部材（６）の振動を抑制する第３の振動抑制手段（３２Ｃ）の作用点（ＣＰ）の高さを共に、ベース部材（６）及び移動ステージ（２０）よりなる系の重心（Ｇ）の高さと実質的に等しくしたときには、その第１の方向の回り及び第２の方向の回りの回転発生が抑制される。また、その第１の方向及び第２の方

向に垂直な方向（Ｚ方向）の回りの回転、並びにその第１の方向及び第２の方向への並進移動を、第２の振動抑制手段（３２Ａ，３２Ｂ）及び第３の振動抑制手段（３２Ｃ）で制御できるため、軸間干渉が最小限に抑制される。

【００１６】

【実施例】以下、本発明による防振装置の一実施例につき図面を参照して説明する。本実施例は、ステッパー型の投影露光装置の防振台に本発明を適用したものである。図１は、本例の投影露光装置の正面図を示し、この図１において、設置面としての床１の上に４個の台座２Ａ，２Ｂ，…（図１では２Ａ，２Ｂのみが現れている、以下同様）が設置され、これら４個の台座２Ａ，２Ｂ，…上にそれぞれ上下動機構３Ａ～３Ｃを介して防振パッド４Ａ～４Ｄが設置され、これら防振パッド４Ａ～４Ｄ上に加重センサ５Ａ～５Ｄを介して投影露光装置の定盤６が設置されている。ここで、後述のように本実施例では投影光学系２５が使用されているため、投影光学系２５の光軸に平行にＺ軸を取り、Ｚ軸に垂直な平面内で図１の紙面に平行にＸ軸を、図１の紙面に垂直にＹ軸を取る。

【００１７】図３は、図１のＡＡ線に沿う断面図を示し、この図３に示すように、上下動機構３Ａ～３Ｄ、防振パッド４Ａ～４Ｄ、及び加重センサ５Ａ～５Ｄは、それぞれ定盤６の四角形の底面の４個の頂点付近に配置されている。上下動機構３Ａ～３Ｄとしては、例えばねじを駆動モータにより回転させて高さを調整する電動式の高さ調整機構が使用され、上下動機構３Ａ～３ＤのＺ方向への高さ調整量は、装置全体の動作を統轄制御する制御装置１１により制御される。また、防振パッド４Ａ～４Ｄとしては、空気式ダンパ、又はダンピング液中に圧縮コイルばねを入れた機械式ダンパ等が使用される。防振パッド４Ａ～４Ｄとして空気式ダンパを使用する場合、空気の圧力により防振パッド４Ａ～４Ｄの高さを調整できるため、その空気式ダンパはそれぞれ上下動機構３Ａ～３Ｄと防振パッド４Ａ～４Ｄとを兼用できることになる。また、加重センサ５Ａ～５Ｄとしては、歪みゲージ等からなるロードセルが使用でき、加重センサ５Ａ～５Ｄにより計測される定盤６からの加重、即ち、防振パッド４Ａ～４Ｄから定盤６に対するＺ方向への反力が制御装置１１に供給されている。

【００１８】図１に戻り、台座２Ａと定盤６との間に防振パッド４Ａと並列にアクチュエータ７Ａが設置されている。アクチュエータ７Ａは、台座２Ａ上に固定された固定子９Ａと定盤６の底面に固定された可動子８Ａとより構成され、制御装置１１からの指示に応じてアクチュエータ７Ａは、台座２Ａから定盤６の底面に対するＺ方向への付勢力、又は定盤６の底面から台座２Ａに向かう吸引力を発生する。他の防振パッド４Ｂ～４Ｄにおいても、防振パッド４Ａと同様にそれぞれ並列にアクチュエータ７Ｂ～７Ｄが設置され、これらアクチュエータ７Ｂ～７Ｄの付勢力又は吸引力もそれぞれ制御装置１１により設定される。アクチュエータ７Ａ～７Ｄは同一構成であるため、アクチュエータ７Ａの構成につき説明する。

【００１９】図２（ａ）は本例のアクチュエータ７Ａを示し、この図２（ａ）において、固定子９Ａは、Ｎ極の軸９Ａａの両側にＳ極の軸９Ａｂ，９Ａｃが形成された発磁体よりなる。また、可動子８Ａは、軸９Ａａに遊嵌する内筒１２、この内筒１２の外側に巻回されたコイル１３、及びこのコイル１３を覆う外筒１４より構成され、コイル１３に流れる電流を調整することにより、固定子９Ａと可動子８Ａとの間に軸９Ａａに平行な方向（±Ｚ方向）への力が発生する。

【００２０】図２（ｂ）はそのアクチュエータ７Ａの別の例を示し、この図２（ｂ）において、第１部材１５に磁性体の固定子１６が固定され、第２部材１７に固定子１６を挟むように内筒１８Ａ及び１８Ｂが固定され、内筒１８Ａ及び１８Ｂの外側にそれぞれコイル１９Ａ及び１９Ｂが巻回されている。この場合も、コイル１９Ａ及び１９Ｂに流す電流を調整することにより、第１部材１５と第２部材１７との間の吸引力のバランスを変化させて力を発生する。

【００２１】図１に戻り、床１と定盤６の底面の中央部との間に、床１に対する定盤６のＺ方向への変位を検出するための変位センサ１０が設置され、変位センサ１０の検出結果も制御装置１１に供給されている。変位センサ１０としては、例えば分解能０．１mm程度のポテンショメータ、又は光電式のリニアエンコーダ等が使用できる。

【００２２】また、定盤６上にウエハステージ２０が固定され、ウエハステージ２０上にウエハホルダ２１を介してウエハ２２が吸着保持されている。定盤６上でそのウエハステージ２０を囲むように第１コラム２４が植設され、第１コラム２４の上板の中央部に投影光学系２５が固定され、第１コラム２４の上板に投影光学系２５を囲むように第２コラム２６が植設され、第２コラム２６の上板の中央部にレチクルステージ２７を介してレチクル２８が載置されている。ウエハステージ２０は、３次元的にウエハ２２の位置決めを行うと共に、ウエハ２２の回転、及びレベリングを行う機能を有し、レチクルステージ２７は、レチクル２８の２次元的な位置の微調整、及び回転角の調整を行う機能を有する。レチクル２８の上方に照明光学系２９が配置され、照明光学系２９からの露光用の照明光のもとで、レチクル２８のパターンの投影光学系２５を介した像がウエハ２２の各ショット領域に順次露光される。

【００２３】図３に示すように、第１コラム２４は４本の脚部２４ａ～２４ｄにより定盤６上に接触している。また、定盤６上のウエハステージ２０の近傍に水平面からの傾斜角のずれ量を検出するためのレベルセンサ２

３、及び定盤６の加速度を検出するための加速度センサ３０が設置され、レベルセンサ２３及び加速度センサ３０による検出結果が制御装置１１に供給されている。加速度センサ３０は、Ｘ方向、Ｙ方向、及びＺ方向への加速度の他に、ピッチング（ＸＺ平面内の回転）、ヨーイング（ＹＺ平面内の回転）、及びＸＹ平面内での回転方向の加速度（角加速度）を検出する機能を有する。即ち、加速度センサ３０は、６個の自由度を有する加速度を検出する機能を有する。

【００２４】更に、定盤６の－Ｘ方向の側面に可動軸３５Ａが埋め込まれ、可動軸３５Ａと床上に固定された支柱３１Ａとの間にアクチュエータ３２Ａが取り付けられている。アクチュエータ３２Ａは、アクチュエータ７Ａと同様に、支柱３１Ａに固定された発磁体よりなる固定子３４Ａと、可動軸３５Ａに取り付けられたコイルを含む可動子３３Ａとより構成され、制御装置１１から可動子３３Ａ内のコイルに流れる電流を調整することにより、可動軸３５Ａに対して＋Ｙ方向又は－Ｙ方向に力を与えることができる。

【００２５】同様に、定盤６の＋Ｘ方向の側面に可動軸３５Ｂが埋め込まれ、可動軸３５Ｂと床上に固定された支柱３１Ｂとの間に、アクチュエータ３２Ａと同一構成のアクチュエータ３２Ｂが取り付けられ、制御装置１１からの指示により可動軸３５Ｂに対して＋Ｙ方向又は－Ｙ方向に力を与えることができるようになっている。また、定盤６の＋Ｘ方向の側面の中央部と床上の支柱３１Ｃとの間に、固定子３４Ｃと可動子３３Ｃとからなるアクチュエータ３２Ｃが設置され、制御装置１１からの指示によりアクチュエータ３２Ｃを介して定盤６に対して＋Ｘ方向、又は－Ｘ方向に力を与えることができる。

【００２６】また、図１に戻り、支柱３１Ａ，３１Ｂ及び３１Ｃはそれぞれ床上に第１コラム２４に沿って植設されている。そして、定盤６、ウエハステージ２０、ウエハホルダ２１、１コラム２４、投影光学系２５、第２コラム２６、及びレチクルステージ２７よりなる系の重心が位置Ｇにあるとする。更に、アクチュエータ３２Ａ，３２Ｂによる可動軸３５Ａ，３５Ｂの第１コラム２４との接続部の中心をそれぞれ作用点ＡＰ及びＢＰとして、図３に示すように、アクチュエータ３２Ｃの可動子３４Ｃの第１コラム２４との接続部の中心を作用点ＣＰとする。このとき本例では、３つの作用点ＡＰ，ＢＰ及びＣＰのＺ方向の位置をそれぞれその重心位置Ｇに対してＺ方向で同じ位置（高さ）に設定する。

【００２７】次に本実施例の動作につき説明する。先ず、本実施例では、図１及び図３に示すように、荷重センサ５Ａ～５Ｄで計測された各防振パッド４Ａ～４Ｄ毎の定盤６に対する反力は、制御装置１１に伝えられている。また、定盤６上のレベルセンサ２３で計測された定盤９の水平レベル、及び変位センサ１０で計測された定盤６の高さも制御装置１１に伝えられている。これらのデータを基に制御装置１１は、定盤６の高さ及び水平レベル（傾斜角）をそれぞれ予め設定されている値にするための、各防振パッド４Ａ～４Ｄの高さを算出する。その際、各防振パッド４Ａ～４Ｄから定盤６に伝えられる反力のバランスが、予め設定されている状態になるよう各防振パッド４Ａ～４Ｄの高さは決められる。その後、制御装置１１は、上下動機構３Ａ～３Ｄを介して防振パッド４Ａ～４Ｄの高さをそれぞれその算出された高さに設定する。その後、防振パッド４Ａ～４Ｄの高さはそれぞれその設定値に維持される。これにより、定盤６に歪みが生ずることがなく、定盤６上のウエハステージ２０の位置決め精度等が高精度に維持される。

【００２８】次に、図３に示すように、定盤６上の加速度センサ３０により検出される６自由度の加速度の情報が制御装置１１に供給されている。そこで、制御装置１１は、その６自由度の加速度をそれぞれ０にするように、Ｚ方向用の４個のアクチュエータ７Ａ～７Ｄ、Ｙ方向用の２個のアクチュエータ３２Ａ，３２Ｂ、及びＸ軸用の１個のアクチュエータ３２Ｃを駆動する。これによって、定盤６上の露光本体部の６自由度の揺れを止めることができる。

【００２９】このとき、Ｘ軸用のアクチュエータ３２Ｃの作用点ＣＰ、及びＹ軸用の２個のアクチュエータ３２Ａ，３２Ｂの作用点ＡＰ，ＢＰは、本例の定盤６上の振動系（振動抑制対象物）の重心位置Ｇに対してＺ方向でほぼ等しい位置（高さ）に設置されている。従って、Ｘ軸及びＹ軸回りの回転を発生させることなくＺ軸回りの回転、並びにＸ軸、及びＹ軸方向の並進振動をＸ軸用のアクチュエータ３２Ｃ及びＹ軸用のアクチュエータ３２Ａ，３２Ｂで制御することができるため、軸間干渉が最小限に抑制される。

【００３０】なお、上述実施例では、Ｘ軸用のアクチュエータ３２Ｃの作用点ＣＰ、及びＹ軸用のアクチュエータ３２Ａ，３２Ｂの作用点ＡＰ，ＢＰは、重心位置Ｇに対してほぼ同じ高さに設定されているが、或る程度の軸間干渉が許容できる場合には、必ずしもそれらの作用点ＡＰ～ＣＰの高さを重心位置Ｇに合わせる必要はない。また、例えばＸ軸用のアクチュエータ３２Ｃの作用点ＣＰのみを重心位置Ｇに対してほぼ同じ高さに設定するようにしてもよい。

【００３１】なお、上述実施例はステッパー方式の投影露光装置に本発明を適用したものであるが、本発明はステップ・アンド・スキャン方式等の走査露光型の投影露光装置にも適用できる。特に、走査露光型では走査露光の開始時に大きな加速度が発生するため、本例のように定盤６の揺れを止めるアクチュエータが備えられている防振台は有効である。

【００３２】また、図１では上下動機構３Ａ～３Ｄとは別にＺ方向用のアクチュエータ７Ａ～７Ｄが設けられているが、上下動機構３Ａ～３Ｄでそのアクチュエータを

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兼用してもよい。但し、防振パッド４Ａ～４Ｄと並列に配置されたアクチュエータ７Ａ～７Ｄを使用することにより、少ない力で、且つ高い応答速度で定盤６の揺れを抑制できる利点がある。更に、定盤６の底面には４個以上の防振パッドを配置してもよく、６自由度以上のアクチュエータを配置してもよい。

【００３３】このように、本発明は上述実施例に限定されず、本発明の要旨を逸脱しない範囲で種々の構成を取り得る。

【００３４】

【発明の効果】本発明の第１の防振装置によれば、加重センサの検出結果に応じて高さ調整手段の調整量を制御するようにしているため、複数の防振パッドからベース部材（定盤）に対する反力のバランスを所望の状態に維持でき、ベース部材で発生する歪みを少なくできる利点がある。

【００３５】また、振動抑制手段を設けることにより、ベース部材上で発生する振動を抑制できる利点がある。特に、その振動抑制手段を防振パッドと並列に配置する場合には、少ない力で且つ高い応答速度でそのベース部材上で発生する振動を抑制できる。次に、本発明の第２の防振装置によれば、防振パッドからベース部材に対する反力のバランスを所望の状態に設定できると共に、合計で７個以上の振動抑制手段を介してベース部材上で発生する６自由度の振動を迅速に抑制できる利点がある。従って、ベース部材上の移動ステージの位置決め精度が高精度に維持される。

【００３６】また、第１の方向に対するベース部材の振動を抑制する第２の振動抑制手段の作用点、及び第２の方向に対するベース部材の振動を抑制する第３の振動抑制手段の作用点の高さを共に、そのベース部材及び移動ステージよりなる系の重心の高さと実質的に等しくしたときには、軸干渉を最小限に抑制できる。特に本発明を露光装置に適用すると、設置場所を変更したような場合でも、露光本体部（定盤、ウエハステージ等）に変形が生じさせることなく、水平レベル調整ができる。更に、露光本体部に新機能を追加するため新たな機構を追加して露光本体部の重心が変化する際にも、防振パッドからの反力バランスの変化が最小になるよう高さ調整手段を制御できる。

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【図面の簡単な説明】

【図１】本発明による防振装置の一実施例が適用された投影露光装置を示す正面図である。

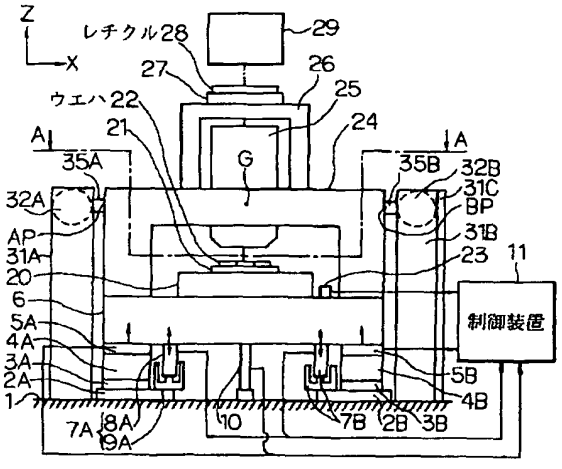
【図２】（ａ）はアクチュエータ７Ａの一例を示す拡大断面図、（ｂ）はアクチュエータ７Ａの他の例を示す拡大断面図である。

【図３】図１のＡＡ線に沿う断面図である。

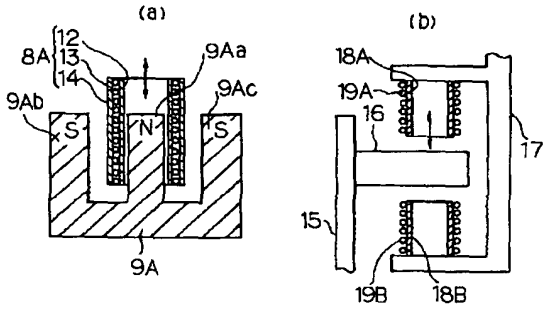
【符号の説明】

３Ａ～３Ｄ　上下動機構
４Ａ～４Ｄ　防振パッド
５Ａ～５Ｄ　加重センサ
６　定盤
７Ａ～７Ｄ，３２Ａ～３２Ｃ　アクチュエータ
１０　変位センサ
１１　制御装置
２０　ウエハステージ
２２　ウエハ
２３　レベルセンサ
２５　投影光学系
２８　レチクル
２９　照明光学系
３０　加速度センサ
３１Ａ～３１Ｃ　支柱

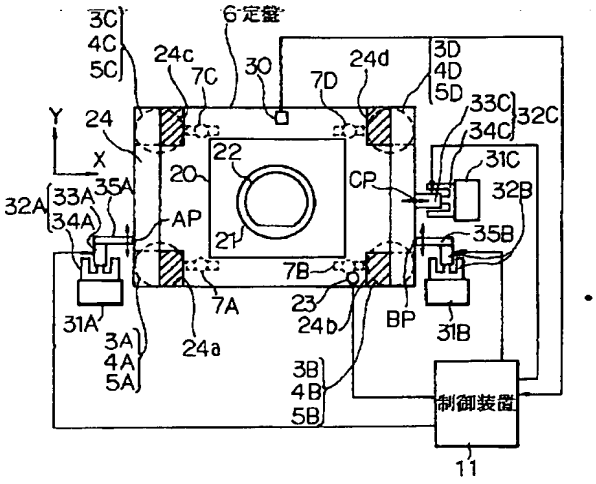
【図１】



【図２】



【図3】


3C
4C
5C
6 定盤
24c
7C
30
7D
24d
3D
4D
5D
33C
34C
32C
Y
24
X
22
20
CP
31C
32B
32A
33A
34A
35A
AP
21
35B
7B
23
24b
BP
31B
31A
7A
24a
3A
4A
5A
3B
4B
5B
制御装置
11